INTERNATIONAL APPLICATION PUBLISHED UNDER THE PATENT COOPERATION TREATY (PCT)

(54) Title: A COOKING SURFACE WITH CONTROLS
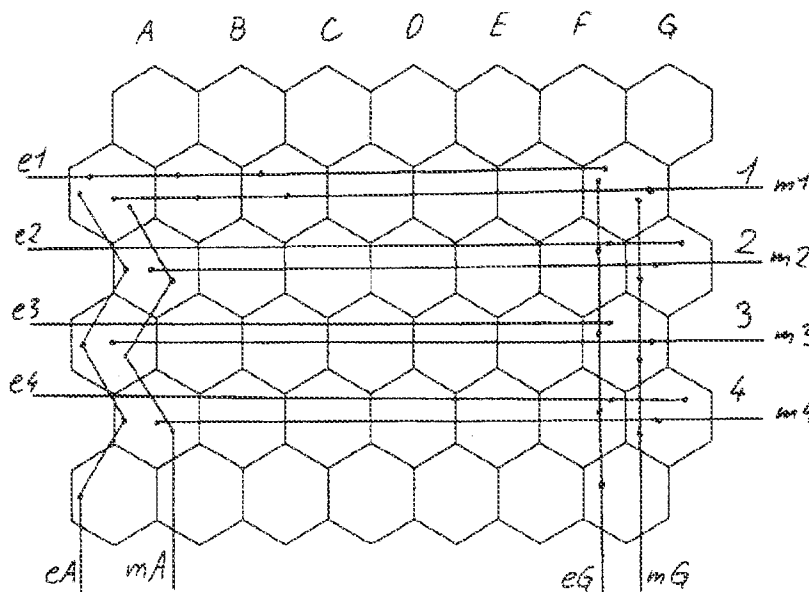
(57) Abstract

A cooking surface consists of a large number of cells arranged in an array. The cells are energized according to the thermal load on them so that cells not covered by a cooking utensil are not energized. The control performs clustering of heat load data and calculates the average thermal load. A cooking utensil may be freely moved about on the surface and the heating it requires will be supplied at any placing. The cells may provide the energy in the form of radiant heating or as energy from induction coils in each cell.

A cooking surface with controls

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The invention relates to a cooking surface
comprising sources of energy and monitoring devices for
the thermal load on the surface which control the power
supply during use and which switch off the power in the
5   case of no load being present.

Present-day cooking surfaces generally consist of
between one and five hot zones which are distributed
below a tough and heat resistant top surface with no
specific delimitations other than markings. A hot zone
10 fitting to the size of the cooking utensil is selected
and energized, and the cooking proceeds, possibly
controlled automatically, either by temperature sensors
directly influenced by the contents or by sensors for
the thermal load comprised by the cooking utensil and
15 the food to be cooked. Such sensors at least have the
ability to switch off the power in case there is no load
in order that overheating of the cooking utensil or a
potentially dangerous situation with a very hot surface
is avoided.

20   In early days, a hot top surface for cooking in
e.g. restaurants had no delimitation of cooking zones,
but the front part (the part nearest to the user) was
the hottest, and the rear part was considered the "back
burner" and sliding from the front to the back permitted
25 bringing the food to its desired temperature at the
front and letting it continue the cooking at the rear.

In order to obtain a similar function in a modern
guise, i.e. a continuous passage from the hotter front
to the relatively cooler back of a cooking surface, DE
30 40 07 680 describes how a number of hot zones are fitted
in matrix fashion in conjunction with a vitroceramic
cooking surface in order that the cooking utensil may be
slid along the surface towards the back when a lower
temperature is needed. Sensors connected to the hot
35 zones only switch on those hot zones which are covered
by the cooking utensil at any one instant. The described
construction aims at avoiding the use of switches or

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other user activated controls since switching-on is
automatic and the temperature is dependent on the
placement of the cooking utensil.

While the above construction gives a good
5   simulation of the temperature distribution in early days
without the constant power consumption and heat loss,
there is perceived a need for a cooking surface which
will service a number of cooking utensils simultaneously
and at the same time to provide individual power supply
10   in dependence of the food to be cooked while still
ensuring full protection against overheating. This need
is not addressed by the described German publication DE
40 07 680.

A construction which addresses this need is
15   particular in that the number of sources of energy is
large, with a minimum of 5 sources, preferably a minimum
of 20 sources, per cooking utensil to be serviced, and
that each source is only energized when its thermal load
is determined as sufficient. In this manner, a cooking
20   utensil may be moved to any place on the cooking surface
to make room for other cooking utensils and still retain
the cooking desired. One standard size cooking utensil
has a diameter of 15 cm, and the number range specified
allows proper regulation of the energy supply to each
25   cooking utensil. The supply of a large number of very
small sources of energy ensures an even heating of both
small and large cooking utensils and enables the heating
of square or rectangular cooking utensils which until
now have not been heatable in a relevant manner, except
30   by putting them in an oven. The determination of thermal
load may be performed using devices according to
international applications PCT/DK94/00456 and
PCT/DK94/00457, to which reference is specifically made.
Alternatively, an array of infrared sensors may be used.
35   In a preferred embodiment of the invention the
arrangement of the sources of energy is in a matrix
fashion. This means that power supply to each source may

occur via columns and rows which reduces the number of switching elements needed to be the sum of columns and rows rather than equal to the total number of sources of heat.

5   In another embodiment the sources of energy are arranged with a minimum of non-heating surface between them. This corresponds to having the maximum of sources of energy within a circular perimeter of a cooking utensil. In this case, the wiring will reflect that such
10   a configuration is in reality only a distortion of a matrix arrangement as above described.

In a preferred embodiment the determination of thermal load occurs in conjunction with each source of energy. In this way, not only is each source of energy
15   only energized when needed, but the precision is enhanced.

In a further preferred embodiment each point of determination of thermal load communicates with a central control unit which performs clustering of heat
20   load data and calculation of an average heat load by cooking utensils, in order to contol the energy supply to the individual sources of energy. This embodiment makes use of image recognition methods which are easily implemented in data processing chips. The information
25   that a thermal load is sufficient from a number of thermal load sensors allows clustering into contiguous areas which constitute an image of the instantaneous distribution of cooking utensils on the cooking surface.

Due to surface irregularities which may appear in
30   some cooking utensil bottoms a higher precision in thermal load determination may be obtained by averaging the individial determinations in a single cluster, and hence it may be avoided that an individual source of heat is switched off due to a local lack of thermal
35   load, although sources of heat immediately surrounding it are still switched on.

In a further embodiment the sources of heat are

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constituted by halogen bulbs which are individually
energized according to the scheme relevant to this
construction. Among other advantages accruing from this
construction is the low thermal capacity of each heat
5   source and its immediate surroundings, enabling a faster
reaction to a cooling requirement similar to the de-
sirable qualities of e.g. gas heating.

     In a further advantageous embodiment the heat is
generated in the cooking utensil by induction coils
10   which are individually energized in the manner of
induction hotplates according to the scheme relevant to
this construction. Thereby the top surface temperatures
may be held at a still lower value which is a distinct
advantage in the present environment comprising a large
15   number of electronic switches.

     The invention will be described in greater detail
in the following with reference to the drawing, in which
     Fig. 1 shows part of the top of a cooker in which
the distribution of a large number of heat sources with
20   thermal load sensors is indicated,
     Fig. 2 shows the perimeter of a cooking utensil
covering a number of energy sources with thermal load
sensors, as well as lines for communcation and energy
supply,   and
25   Fig. 3 shows a block diagram of the
interconnections between the large number of heat
sources with thermal load sensors and a control unit.

     In Fig. 1 is shown a grid which represents part of
the top of a cooker according to the invention. The grid
30   defines cells by means of row indications (1, 2, 3, 4)
and column indications (A, B, C, ..., K), it being
understood that this section of 44 cells is only a part
of the total surface of a cooker in which each cell may
be defined by coordinates, such as 1b or 4j. These are
35   indicated by hatching. Each cell has provisions for
energy supply and provisions for measuring the thermal
load of the cell, such as a probe to which a connection

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may be established.

The cells are supplied with electrical energy by means of a grid of wires (e1, e2, e3, e4) and (eA, eB, eC, ..., eK) respectively. These wires are in turn connected to main supply wires Wr and Wc by in such a manner that only those cells which are simultaneously connected to both horizontal Wr and vertical Wc main supplies are acting as energy sources in the top of the cooker. The selection of grid wires occurs through electronic switches in each wire (se1, se2, se3, se4) and (seA, seB, seC, ..., seK). These switches are controlled by a main controller CC for the cooktop.

In a similar fashion, each cell is connected to a grid of sense wires (m1, m2, m3, m4) and (mA, mB, mC, ... mK) respectively which lead to two data buses Mr and Mc via strobing switches (sm1, sm2, sm3, sm4) and (smA, smB, smC, ..., smK). By means of cyclic strobing, each cell is addressed in turn, and the controller obtains information on the thermal load status of each cell.

In Fig. 2 is shown part of a cooktop with a different tessellation. Each cell 1A through 4G is hexagonal which permits a closer approximation to a circular bottom of a cooking vessel. Although a larger number of rows and a smaller number of columns is shown than in Fig. 1, the designation of the cells has been retained. It will be recognized that the addressing of energy sources and of sensors is identical to the rectangular type grid, although the column grid wires may take two different courses as shown at eA, mA and eG, mG respectively.

In Fig. 3 is shown a block diagram of the interconnection between the supply and feedback systems and the power supply unit and control unit respectively. According to one embodiment of the invention a primitive image processing system is involved in that information on clusters of similarly indicating sensors at any one time permits an outline of a thermal load area to be

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defined. The cooking vessel is regarded as being
positioned within this outline, and the power supplied
to each cell is equalized. Alternatively, a subcluster
of cells representing a low load area within the outline
5   may be supplied with a higher level of energy in order
to decrease the cooking time, letting the standard
reading from the majority of cells within the outline
determine if an increasing low load situation,
designating dry cooking or removal of a cooking vessel
10   is occuring.

       In one embodiment of the invention, a cooking
surface is supplied with a vast number of halogen bulbs
with individual reflectors supported by a perforated
plate, one hole for each bulb.

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PATENT CLAIMS

1. A cooking surface comprising sources of energy and monitoring devices for the thermal load on the surface which control the power supply during use and which switch off the power in the case of no load being present, c h a r a c t e r i s e d   i n   that the number of sources of energy is large, with a minimum of 5 sources, preferably a minimum of 20 sources, per cooking utentil to be serviced, and that each source is only energized when its thermal load is determined as sufficient.

2. A cooking surface according to claim 1, c h a r a c t e r i s e d   i n   that the sources of energy are arranged in a matrix fashion.

3. A cooking surface according to claim 2, c h a r a c t e r i s e d   i n   that the sources of energy are arranged with a minimum of non-heated surface between them.

4. A cooking surface according to any of the preceding claims, c h a r a c t e r i s e d   i n that the determination of thermal load occurs in conjunction with each source of energy.

5. A cooking surface according to claim 4, c h a r a c t e r i s e d   i n   that each point of determination of thermal load communicates with a central control unit which performs clustering of heat load data and calculation of an average heat load by cooking utensils, in order to control the energy supply to the individual sources of energy.

6. A cooking surface according to any of the above claims, c h a r a c t e r i s e d   i n   that the sources of energy are constituted by halogen bulbs which are individually energized according to the scheme relevant to this construction.

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7.   A cooking surface according to any of the
above claims,   c h a r a c t e r i s e d   i n
that the heat is generated in the cooking utensil by
induction coils which are individually energized in the
5   manner of induction hotplates according to the scheme
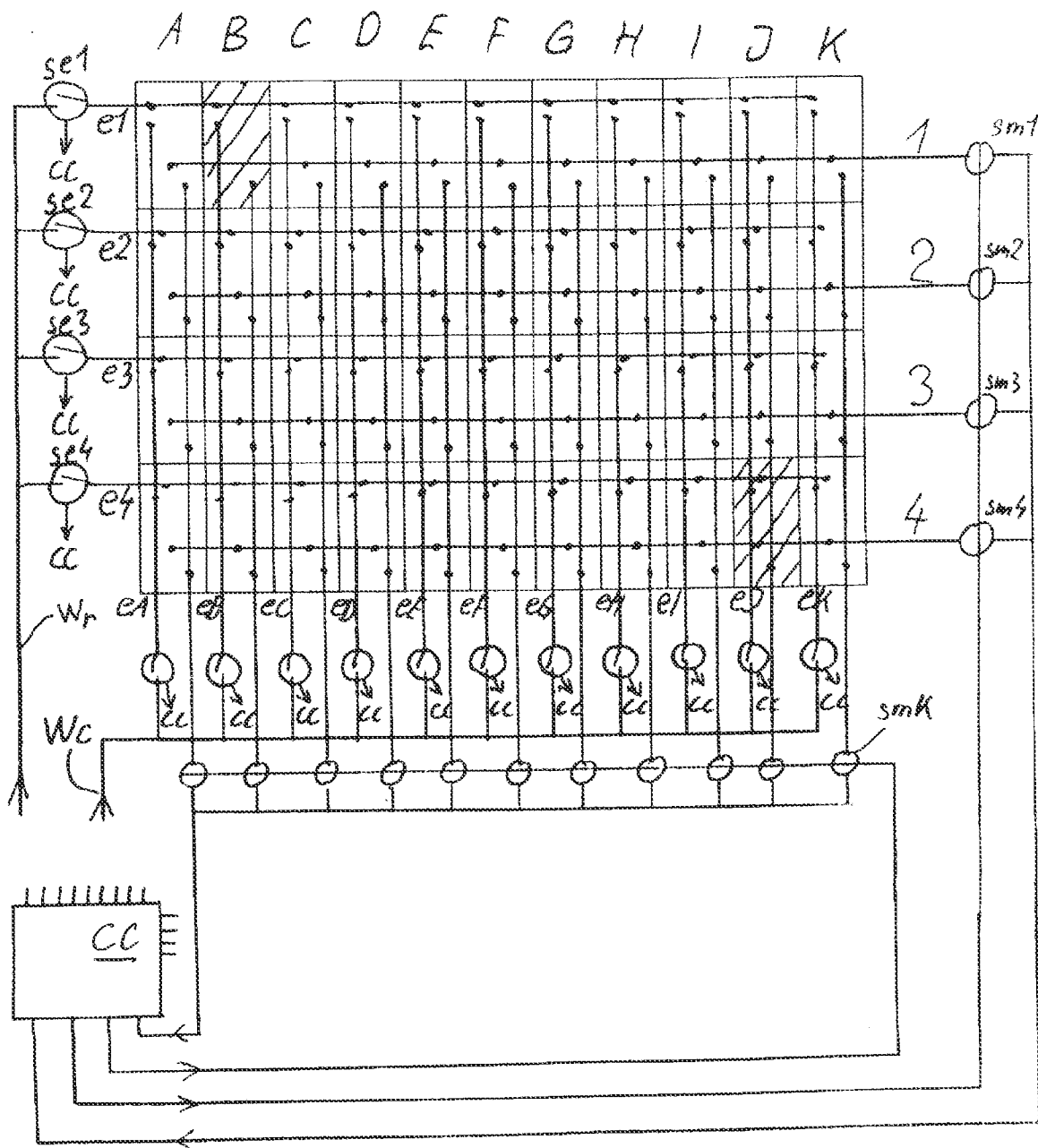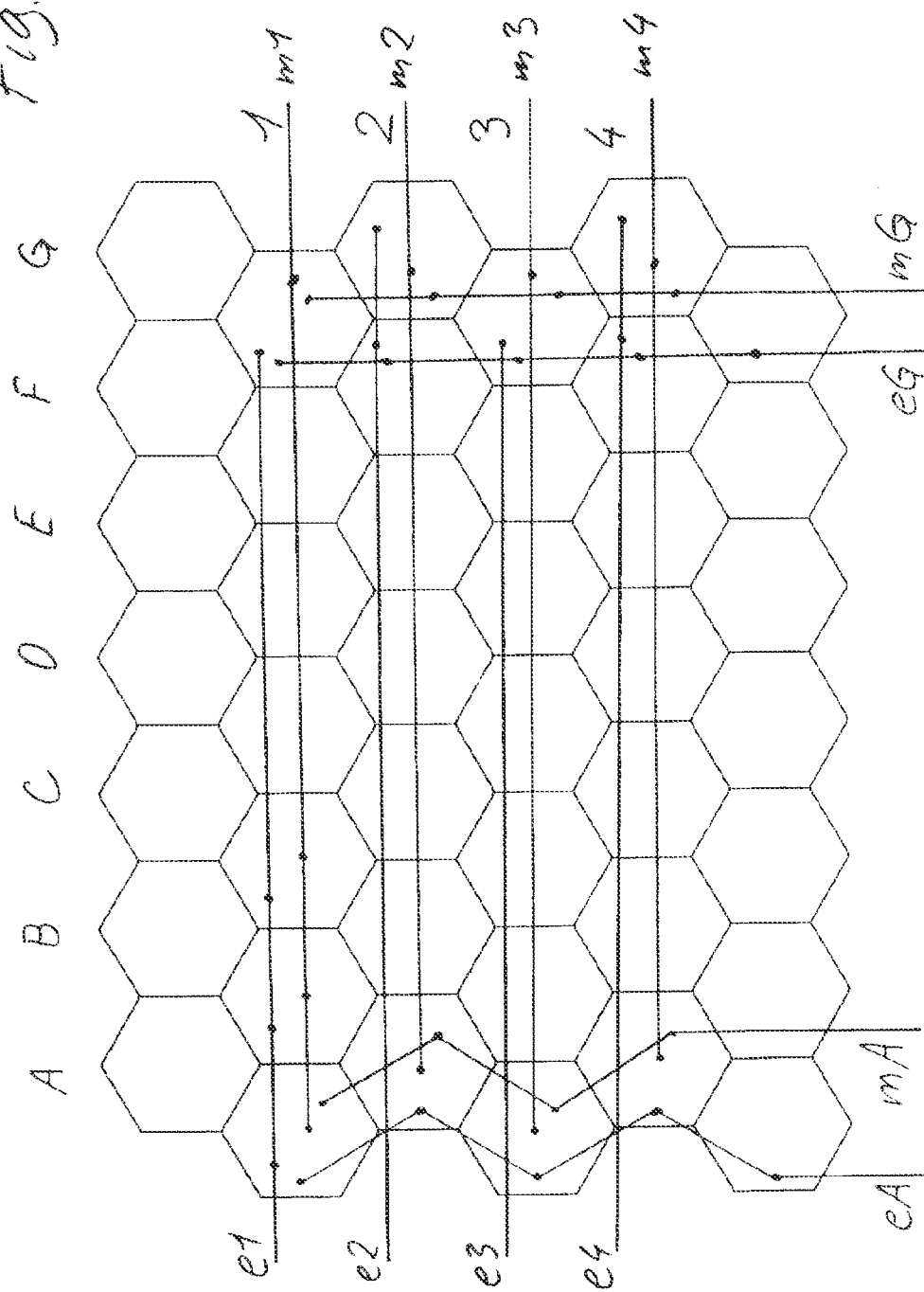relevant to this construction.

Fig. 1.

Fig. 2

Fig. 3